

SAFETY PRACTICES TEACHER GUIDE

Best Practices for Safe Operation

- Before using a laser cutter, be sure you have been trained by a qualified individual. A written procedure covering laser cutter use is recommended.
- Always follow the manufacturer's instructions when operating a laser cutter.
- Keep a logbook detailing who has used the laser cutter, cutting time, and materials cut.
- A fire extinguisher should be mounted on the wall near the laser cutter.
- Regular vacuuming of the cutting deck and the internal cavity of the laser cutter is very important for preventing fires!
- Know what materials can be safely cut! Some materials such as PVC produce hydrogen chloride gas which is extremely dangerous. If you are unsure if your material is safe to cut, contact your EHS Coordinator or the MIT EHS Office at 617-452-3477.
- Never leave an operating laser cutter unattended.
- Avoid placing the laser cutter on wood and other combustible surfaces.
- Know how setting the pulse rate of the laser affects the chance of a fire and the resolution of the cut.
- Never defeat laser interlocks built into the cutter. This could allow the beam to escape from the laser cutter.

Potential Hazards

Users should be trained on the hazards of laser cutters and know that when a laser cutter is properly setup and operated, the potential for these hazards is greatly minimized. All laser cutter users should be aware of the following:

Fire Risk

Even a properly maintained and exhausted laser cutter may occasionally have flare-ups that unobserved can progress to a larger fire. Knowing how to respond to flare-ups and fires is key information for every user and is discussed later in this guidance.

Laser cutter fires usually have one of more of the following contributing factors:

- Not observing the laser cutter while operating
- Incorrect power and pulse settings
- Insufficient exhaust
- Unsuitable material
- Dirty optics
- Laser cutter not cleaned out regularly

Respiratory Hazard

The high heat from laser cutting as it burns, melts, or vaporizes material can generate the same combustion by-products as a fire, therefore inhaling smoke from a laser cutter can have health concerns

like smoke from burning materials. These include respiratory irritation and inhalation of toxic particles and gases.

By using a properly setup laser cutter and following established procedures, these air contaminants will be exhausted completely. Note that it is best practice to leave a completed job in the laser for 10 to 15 sec or longer depending on the material to allow the piece time to cool, and any residual smoke and odors to exhaust and off-gas.

Laser Hazard

Most commercially available laser cutters are housed inside an enclosure that reduces the hazard level of the Class 4 laser to Class 1. Damage or injury to the eye or skin is possible with laser cutting or etching equipment if the equipment laser interlocks are tampered with, bypassed or if optics maintenance is not conducted in accordance with the manufacturer's specifications (usually by a trained manufacturer service rep).

Viewing windows are designed to allow visual observation of flare ups, and should not be covered to "keep the laser in." Contact the Radiation Protection Program with any questions concerning laser safety.

Laser Cutter Exhaust and Air Assist

Ensuring that your laser cutter is adequately exhausted according to manufacturer recommendations is critical for safe and effective use. Both exhaust for the unit itself and general room ventilation with single-pass air would be an inappropriate location for a laser cutter.

Exhaust System

In most cases, only specially designed exhaust systems generate enough static pressure to support most laser cutters. Before purchasing a laser cutter, provide EHS and DOF with the laser cutter exhaust requirements and ask them to evaluate the ventilation where the laser cutter will be located. If you have questions about an existing laser cutter's exhaust, contact EHS to evaluate and discuss options to improve the exhaust if necessary.

Laser cutters with insufficient exhaust do not remove debris and heat as efficiently. The laser optics will get dirty quickly resulting in poorer focusing and laser beam scatter; both of these conditions may contribute to the likelihood of a fire.

Filtration Systems

When the existing exhaust system does not have sufficient static pressure or capacity (cfm), there are a few options such as using a filtration unit to exhaust your laser cutter. Filtration systems, if properly designed and meticulously maintained, also clean the airstream in addition to exhausting the laser cutter. However, there have been several instances at MIT of poorly designed or maintained filtration units leading to odors in labs and shops. It is recommended that the filtration unit outputs into an exhaust system when feasible. If your laser cutter is only used occasionally, you have good general ventilation, and you limit use to a few materials, then a filter unit exhausting into the shop may be

an option. Discuss with the filter vendor whether or not a filtration unit would work for your laser cutter and for your planned usage. They can assist in ensuring you obtain the right system for your laser cutter. EHS may also be able to assist.

Air Assist

The air assist provides compressed air to remove debris and heat at the laser cut point and can be helpful in preventing flare-ups and charring especially for more combustible materials. If this is an optional feature, EHS recommends including this feature when specifying your laser cutter. Know how your air assist functions; there is a wide variation in how they are integrated into laser cutters depending on manufacturer and model.

Before laser cutter use, check that the air assist is functioning properly.

Allowable and Prohibited Materials

Each laser cutter owner should develop a list of allowable and prohibited materials. These lists may vary between shops due to laser cutter model, type of shop/makerspace, and whether the laser cutter is exhausted by a filtration system or building exhaust. Common considerations when developing your list include:

- Prohibit PVC and other chlorinated thermoplastics because processing them in a laser cutter generates hydrogen chloride and corrodes optics.
- Foam core has been involved in fires at MIT and other locations. Suggest other means of cutting to users.